WHAT IS CLAIMED IS:

1. A process for forming graded body diode regions, comprising:

selecting a semiconductor substrate having a front surface and a back surface opposite of the front surface, the substrate comprised of silicon doped with a dopant of a first conductivity type;

implanting and diffusing channel diffusions in the front surface of the substrate, the channel diffusions being of a second conductivity type having an opposite conductivity to the first conductivity type, the channel diffusions defining spaces between the channel diffusions, the spaces having a conductivity of the first conductivity type;

implanting and diffusing enhancement diffusions of the first conductivity type in the spaces, increasing the concentration of the first conductivity type in the spaces;

implanting and diffusing second diffusions having opposite conductivity type in the channel diffusions such that the second diffusions overlap the enhancement diffusions, each of the second diffusions defining left and right boundary regions between the portion of the substrate in the channel diffusions having a net conductivity of the second conductivity type and the portion of the substrate in the spaces having a net concentration of the first conductivity type;

implanting and diffusing shallow diffusions within the second diffusions, defining a shallow, partially counterdoped region in a portion of the channel diffusions, the net concentration of the counterdoped region remaining the second conductivity type, but having a lower net concentration than surrounding portions of the channel diffusions; and

implanting and activating source diffusions of the first conducitivity type in the channel diffusions such that the source diffusions have a net concentration of the first conductivity type surrounding by a region of the channel diffusions having a net

concentration of the second conductivity type, wherein graded body diode regions are formed.

2. The process of claim 1, wherein the step of implanting and activating comprises:

implanting pairs of left and right source diffusions of said first conductivity type, each of the pairs of left and right source diffusions being disposed in each of the second diffusions such that the left source diffusion overlaps a left portion of the counterdoped region and the right source diffusion overlaps a right portion of the counterdoped region opposite of the left portion, the pairs of source diffusions defining a gap in the counterdoped region between the left source diffusion and the right source diffusion.

3. The process of claim 1, wherein the step of implanting and diffusing channel diffusions comprises:

growing an oxide layer on the substrate;

depositing a photoresist layer atop the oxide layer; and

forming narrow implant windows in the oxide layer using photolithographical masking to define the narrow implant windows in the oxide layer;

implanting the channel diffusions; and

diffusing the channel diffusions, such that each of the channel diffusions has a net concentration of the second conductivity type, a width and a depth.

4. The process of claim 3, wherein the step of implanting and diffusing enhancement diffusions comprises:

cleaning the front surface prior to the step of diffusing the channel diffusions;

applying an enhancement photoresist mask on a surface of an oxide layer, the oxide layer being grown on the substrate during the step of diffusing the channel diffusions;

forming, photo-lithographically, narrow enhancement windows in the oxide layer;

implanting the enhancement diffusions in the enhancement windows; and

diffusing the enhancement diffusions;

5. The process of claim 4, wherein the step of implanting and diffusing second diffusions comprises:

masking the front surface of the substrate defining unmasked regions;

implanting second diffusions of the second conductivity type in the unmasked regions; and

diffusing the second diffusions.

6. The process of claim 5, wherein the step of implanting and diffusing shallow diffusions comprises:

narrowing, by forming spacers, the unmasked region defined by the previous step of masking the front surface in implanting and diffusing second diffusions;

implanting shallow diffusions of the first conductivity type such that each of the shallow diffusions are self-aligned within each of the second diffusions, respectively;

removing the spacers; and

diffusing the shallow diffusions.

7. The process of claim 6, wherein the step of implanting and activating comprises:

implanting pairs of left and right source diffusions of said first conductivity type, each of the pairs of left and right source diffusions being disposed in each of the second diffusions such that the left source diffusion overlaps a left portion of the counterdoped region and the right source diffusion overlaps a right portion of the counterdoped region opposite of the left portion, the pairs of source diffusions defining a gap in the counterdoped region between the left source diffusion and the right source diffusion.

8. The process of claim 3, wherein the step of implanting channel diffusions comprises implanting boron ions at an energy of about 120 keV and a dose of about 1E13.

9. The process of claim 8, wherein the step of diffusing channel diffusions comprises:

cleaning the flat junction receiving region;

heating at a selected temperature and for a selected duration, such that the channel diffusions extend to a depth of about 2.5 microns and a width nearly equal to the depth.

10. The process of claim 4, wherein the steps of implanting enhancement diffusions comprises:

implanting phosphorus ions at an energy of about 80 keV and a dose in a range from about 2E13 to 3E13.

11. The process of claim 10, wherein the steps of implanting and diffusing enhancement diffusions further comprises:

stripping the photoresist mask;

heating at a selected temperature and for a selected duration such that the enhancement diffusions extend to a depth of about 8000 angstroms.

12. The process of claim 5, wherein the step of masking the front surface comprises:

applying a layer of photoresist to an oxide layer formed during the previous step of diffusing the enhancement diffusions;

patterning the layer of photoresist;

plasma etching a portion of the oxide layer, forming narrow windows, defining the unmasked regions.

13. The process of claim 12, wherein the steps of implanting and diffusing second diffusions further comprises:

growing a screening oxide layer that is thinner than the oxide layer grown during the step of diffusing the enhancement diffusions; and

implanting boron ions through the screening oxide at an selected energy and a selected dose; and

diffusing the boron ions at a selected temperature and for a selected durations such that the second diffusions extend to a depth of about 1.7 microns.

14. The process of claim 13, wherein the step of implanting boron ions through the screening oxide comprises selecting the selected energy to be about 50 keV and the selected dose to be about 2E14.

15. The process of claim 6, wherein the step of narrowing, comprises:

forming a layer of undoped polysilicon; and

etching the layer of polysilicon, forming the spacers along the sides of the unmasked region.

16. A process for forming a radiation-hardened MOSFET using a silicon substrate of a first conductivity type, comprising:

selecting a semiconductor substrate having a front surface and a back surface opposite of the front surface, the substrate comprised of silicon doped with a dopant of a first conductivity type;

implanting and diffusing channel diffusions in the front surface of the substrate, the channel diffusions being of a second conductivity type having an opposite conductivity to the first conductivity type, the channel diffusions defining spaces between the channel diffusions, the spaces having a conductivity of the first conductivity type;

implanting and diffusing enhancement diffusions of the first conductivity type in the spaces, increasing the concentration of the first conductivity type in the spaces;

implanting and diffusing second diffusions having opposite conductivity type in the channel diffusions such that the second diffusions overlap the enhancement diffusions, each of the second diffusions defining left and right boundary regions between the portion of the substrate in the channel diffusions having a net conductivity of the second conductivity type and the portion of the substrate in the spaces having a net concentration of the first conductivity type;

implanting and diffusing shallow diffusions within the second diffusions, defining a shallow, partially counterdoped region in a portion of the channel diffusions, the net concentration of the counterdoped region remaining the second conductivity type, but having a lower net concentration than surrounding portions of the channel diffusions;

implanting and activating source diffusions of the first conducitivity type in the channel diffusions such that the source diffusions have a net concentration of the first conductivity type surrounding by a region of the channel diffusions having a net

concentration of the second conductivity type, wherein inverted channel regions and graded body diode regions are formed;

forming gate electrodes electrically coupled to the surface of the substrate and at least one gate contact, each of the gate electrodes being disposed over one of the enhancement diffusions and extending at least partially over inverted channel regions on each side of the one of the enhancement diffusions;

forming source electrodes electrically coupled to at least one source contact and electrically isolated from the gate electrodes, each of the source electrodes being disposed over at least a portion of respective source diffusions; and

forming at least one drain electrode electrically coupled to the substrate such that the gate electrodes are capable of switching an electrical current from the source electrodes to the gate electrodes on and off in response to a voltage applied at the at least one gate contact.

17. The process of claim 16, wherein the step of implanting and activating comprises:

implanting pairs of left and right source diffusions of said first conductivity type, each of the pairs of left and right source diffusions being disposed in each of the second diffusions such that the left source diffusion overlaps a left portion of the counterdoped region and the right source diffusion overlaps a right portion of the counterdoped region opposite of the left portion, the pairs of source diffusions defining a gap in the counterdoped region between the left source diffusion and the right source diffusion.

18. The process of claim 17, wherein the step of forming gate electrodes comprises:

cleaning the surface of the substrate;

forming a gate oxide layer on the substrate; and

depositing a conductive gate polysilicon segment on a portion of the gate oxide layer.

19. The process of claim 18, wherein the step of forming source electrodes comprises:

forming an electrically insulating layer on the polysilicon segment; and

metalizing the source electrodes, such that each of the source electrodes overlies and makes electrical contact, respectively, with at least a portion of both of the left and right source diffusions of one of the pairs of the left and right source diffusions.

20. The process of claim 19, wherein the step of forming the at least one drain electrode comprises:

cleaning the back surface of the substrate; and

applying a Ti/Ni/Ag drain metal to the back surface.